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APPLICATION FOR

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METHOD FOR OPTIMIZING REFUELING OF RAIL VEHICLES

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METHOD AND DEVICE FOR OPTIMIZING REFUELING OF RAIL VEHICLES

Related Applications

[0001] The benefit of priority of the non-provisional application 102 34 544.9 filed on July 30, 2002 in the German Patent Office, is hereby claimed.

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0002] The invention relates to a method and a device for optimizing the refueling of rail vehicles.

[0003] Rail vehicles (diesel locomotives) are used for transporting goods and people over rail networks. Such rail vehicles have to be refueled from time to time, and the time for refueling and optionally also the price of the fuel depends on the selected refueling station and can be different for different locations.

[0004] Since such fuel tank has a fuel capacity of up to 1000 l, the weight of the carried fuel can also be a factor for an energy-saving operating/travel mode of the rail vehicle.

[0005] For optimizing refueling of the rail vehicle, the question also has to be answered if for safety reasons such rail vehicle has to be always driven with a ¾ or half full tank and to carry the corresponding fuel weight, or if it would be more energy-efficient to possibly drive the rail vehicle with the minimum fuel level in the tank that is determined by a safety margin, in order to operate a lighter rail vehicle in a more fuel-efficient manner.

[0006] It is therefore an object of the invention to propose a method for refueling rail vehicles which ensures an optimal refueling mode.

SUMMARY OF THE INVENTION

[0007] Accordingly, the invention concerns determining the instantaneous fuel consumption, depending on a very accurate fuel consumption measurement of the internal combustion engine and supplied to an internal main computer, that an added-up consumption is computed, from which the fuel level in the fuel tank is determined, that the internal main computer in the rail vehicle is connected via a GSM system or similar systems with a master computer, and that furthermore the signals of a GPS system or of similar systems are supplied to the main computer of the rail vehicle for the purpose of determining the location of the rail vehicle.

[0008] The disclosed technical teachings provide the significant advantage in that it is now possible for the first time to determine the actual fuel consumption and the fuel consumption of the rail vehicle added over a time interval at an arbitrary location in the rail network and to influence the fuel consumption accordingly.

[0009] The aforementioned data of the instantaneous location as well as of the instantaneous and the added-up fuel levels are transmitted to the master computer which determines those refueling stations located in the rail network to which the rail vehicle should travel.

[0010] The master computer also knows the capacity of the individual refueling stations and hence can prevent a large number of rail vehicles from being directed to the same refueling station, since its capacity could thereby be exhausted.

[0011] The master computer is also provided with the price information of the different refueling stations - which may even be arranged in a transnational network - in order to arrange for a price-optimized refueling of the rail vehicle.

[0012] The invention also proposes a fleet management of rail vehicles which makes possible for the first time to optimize the fuel consumption based on an energy-saving driving mode.

[0013] Based on the speed of the rail vehicle in the rail network, the master computer can determine the actual speed of the rail vehicle and simultaneously correlate the actual speed with the fuel level of the tank. For example, it can always be ensured that the rail vehicle is always in the rail network with a tank that is only filled to maximally half its capacity, so that less weight has to be carried. However, a certain safety reserve should always exist.

[0014] It may also be advantageous not to fill the tank completely, because the rail vehicle can drive with a higher energy-efficiency if the tank is not completely filled, as compared when the tank is full. This can be autonomously decided by the fleet management program of the master computer.

[0015] The aforedescribed fleet management program makes it also possible for the first time to give off an alarm if an excessive fuel consumption is detected. For example, the rail vehicle could be directed to a service station, where the causes for the high fuel consumptions are determined.

[0016] Finally, the fleet management program and monitoring the consumption of rail vehicles also serves the purpose for quickly solving fuel thefts or for preventing such thefts entirely.

[0017] For this purpose, the computer arranged in the rail vehicle is provided with a long-term data storage (data logger) which is capable of logging the instantaneous and/or absolute fuel consumption over a longer period of time and reproducing the fuel

consumption as a protocol or dataset.

[0018] For example, the data longer is read out after one week and irregularities in the fuel consumption or an unauthorized withdrawal of fuel can be determined. The arrangement of a data logger in the computer of the rail vehicle is also to be claimed as part of the invention in combination with the GSM system and/or GPS system or also without the two afore-mentioned systems or only with one of the afore-mentioned systems.

[0019] The master computer may have stored where repeated thefts have occurred and can direct the rail vehicle past these locations. It is also possible to immediately determine a fuel theft - including the location -, in order to immediately monitor the personnel at this location.

[0020] The invention is also not limited to using a GSM system. Other systems can also be used, such as for example the systems which are customarily employed in the USA and in Japan. It is only important that the aforementioned data are exchanged between the rail vehicle and the master computer via the data connection.

[0021] Instead of the disclosed GPS system, other systems can also be used for determining the actual location of the rail vehicle. For example, the track itself can transmit signals to the rail vehicle, so that the rail vehicle receives the corresponding location information from the rail network itself.

[0022] It is also possible to use the so-called Galileo system instead of the GPS system.

[0023] The invention relates also to diesel-powered rail vehicles, a particular passenger and freight locomotives, but also to trolley cars, switching locomotives and other diesel-powered rail vehicles.

[0024] The subject matter of the present invention is not only based on the individual claims, but also on a combination of the individual claims.

[0025] Other aspects of the present invention will become apparent from the following detailed description considered in conjunction with the accompanying drawings. It is to be understood, however, that the drawings are intended solely for purposes of illustration and not as a definition of the limits of the invention, for which reference should be made to the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0026] The invention will be described hereinafter in more detail based on the drawings which depict a single embodiment. Additional features and advantages essential for the invention can be deduced from the drawings and their description.

Fig. 1 schematically, a diagram for a highly accurate measurement of the consumption of a diesel engine,

Fig. 2 schematically, the arrangement of the different elements in the rail vehicle,

Fig. 3 an overview diagram of a rail network.

DETAILED DESCRIPTION OF THE PRESENTLY PREFERRED EMBODIMENTS

[0027] Fig. 1 depicts a highly accurate measurement of the fuel consumption of a diesel engine 1. The diesel engine 1 is installed in a rail vehicle 2 as depicted in Fig. 3.

[0028] The diesel engine 1 is connected to an injection pump 3 which injects the diesel fuel at a high pressure into the combustion space of the diesel engine 1.

[0029] The inlet of the injection pump 3 is located in an inlet line 5 which includes a first

volumetric measurement device 6 for measuring fuel consumption.

[0030] This volumetric measurement device 6 consists of a dual-screw-spindle volume meter which preferably operates with two sensors 11, 12. These sensors 11, 12 measure the rotation speed of a spindle that is rotatably driven by the fuel.

[0031] The temperature of the diesel fuel is measured by a sensor 36 and transmitted to a computer 17 via a line 8.

[0032] The upper volumetric measurement device 6 is located in the tank inlet 9 of a fuel tank 18.

[0033] The sensors 11, 12 are connected to a pulse selector 13 by corresponding signal lines, with the pulse selector 13 also being connected to the computer 17 via a signal line.

[0034] A similar volumetric measurement device 7 is inserted in the tank return line 10 of the tank 18. The volumetric measurement device 7 is also capable of measuring the mass 15 of the passing fuel. This mass is determined in the computer 17.

[0035] The motor fuel consumption can therefore also be determined via the mass per unit time of the diesel fuel.

[0036] The signals of the two sensors 11, 12 are hereby also supplied to a pulse selector 14, the signals of which are supplied to the computer 17.

[0037] The temperature signal is hereby also supplied to the computer 17 via the line 16.

[0038] The pulse selectors 13, 14 are used to determine the fuel consumption in the fuel system 4 with a high accuracy, even if the fuel shows strong pulsations in the direction of the dual arrow 20.

[0039] The two pulse selectors are used to always determine which of the two volumetric measurement devices 6 or 7 is driven in the forward direction and which is driven in the reverse direction, and difference signals are always formed to ensure a highly accurate fuel consumption measurement.

[0040] This approach can entirely eliminate a measurement of the fill level 19 in the fuel tank 18.

[0041] However, such fill level measurement 19 may be provided in addition.

[0042] By measuring the difference between the temperature of the sensor 36 in the inlet and the corresponding temperature of the sensor 36 in the return path, different temperature expansions of the fuel can be measured and included in the determination of the fuel consumption.

[0043] Accordingly, the two volumetric measurement devices 6, 7 measure the consumed fuel independent of the direction. The aforedescribed volumetric measurement devices 6, 7 are insensitive to high-frequency changes in the flow. Being displacement counters, the measurement spindles follow each movement of the fluid column. The reaction is so direct that one has the impression that a fixed mechanical coupling exists between the fluid and the measurement spindles.

[0044] The measurement is therefore independent of the viscosity and independent of the temperature of the fuel.

[0045] Fig. 2 shows that the data of the computer 17 are supplied via the line 21 to a main computer 22 which is located in the rail vehicle 2.

[0046] The main computer 22 is also connected via the line 25 with a GPS system 26 which supplies to the main computer 22 the actual location information of the rail vehicle

in the rail network 28.

[0047] The main computer 22 is connected via a line 23 with a GSM system 24 which is connected via a data connection with an arbitrary stationary base station 27.

[0048] The base station 27 is connected with the master computer 35 via the conventional telephone network or via a point-to-point connection or via another data connection.

[0049] Fig. 3 shows the advantages of the system according to the invention.

[0050] For example, when the rail vehicle 2 is positioned at location 29 in the rail network 28, the location of the rail vehicle, the instantaneous fuel consumption and the total consumption must be transmitted via the GSM connection, so that the fill level in the tank 18 can be determined therefrom.

[0051] These data are entered in the master computer 35, which then decides which additional route the rail vehicle - depending on the schedule and other operational situations - should take in the rail network 28. In particular, the master computer 35 decides if the rail vehicle should drive at the indicated switch 37 in the direction of arrow 32 to the refueling station 33, or in the direction of arrow 31 to the next refueling station 30. It can also be decided that the rail vehicle 2 should travel across the switch 37 in the direction of arrow 31, but that the fuel level in the tank is sufficient to reach the refueling station 34 located farther away.

[0052] Such a decision is not only made depending of the fuel level in the tank 18, but is also based of the actual speed of the rail vehicle 2, on the instantaneous fuel consumption and the predictable, future fuel consumption and possibly also on price information of the respective refueling stations 30, 33, 34.

[0053] It is particularly advantageous to a fill the fuel tank of the rail vehicle at the refueling station 30 to only half its capacity, and to subsequently travel via an energy-optimized path to the refueling station 34. This approach prevents that the rail vehicle is, for example, filled to capacity at one refueling station 30 and then has to overcome with a full fuel tank and a relatively high payload a long ascending track section 38 between the refueling station 30 and the refueling station 34.

[0054] Accordingly, there are substantial energy savings if the fuel tank of the rail vehicle is only filled to half its capacity before the ascending track section 38 and the rail vehicle travels over the ascending track section with optimized fuel consumption.

[0055] The master computer performs also other functions which are already described in the general section of the specification.

[0056] Thus, while there have been shown and described and pointed out fundamental novel features of the invention as applied to a preferred embodiment thereof, it will be understood that various omissions and substitutions and changes in the form and details of the devices illustrated, and in their operation, may be made by those skilled in the art without departing from the spirit of the invention. For example, it is expressly intended that all combinations of those elements and/or method steps which perform substantially the same function in substantially the same way to achieve the same results are within the scope of the invention. Substitutions of elements from one described embodiment to another are also fully intended and contemplated. It is also to be understood that the drawings are not necessarily drawn to scale but that they are merely conceptual in nature. It is the intention, therefore, to be limited only as indicated by the scope of the claims appended hereto.